BELLCOMM, INC.

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869 03052

SUBJECT: Effect of Antenna Pointing Error on Early Apollo Scientific Experiments Payload (EASEP) Communications Performance - Case 320

DATE: March 14, 1969

FROM: K. H. Schmid

MEMORANDUM FOR FILE

Deployment of the EASEP on the lunar surface includes (a) leveling the equipment, (b) adjusting the equipment for correct azimuth, and then (c) elevating the S-Band antenna so that it points toward Earth. Pointing is accomplished by raising the antenna until the elevation pointer is directed at the appropriate lunar landing site number which is inscribed on an index plate. No further alignment is required after these steps.

Ideally, the antenna then should be pointed at the mean position of the Earth. (The Earth's actual position moves slightly with time because of lunar libration.) A typical pointing error of 5 degrees* (angle between the actual antenna pointing direction and the mean position of the Earth) is caused by imperfect deployment, and equipment tolerances. An additional pointing error of 8 degrees maximum* (angle between the mean position of the Earth and the actual position of the Earth) is caused by lunar libration. Therefore, the typical peak pointing error is 13 degrees. However, peak pointing errors in excess of 15 degrees occur for 0.5% of the time.*

Specifications state that the transmit antenna gain on boresight shall be a minimum of 15.2 db, and the beamwidth at the 11.5 db gain points shall be a minimum of 27 degrees. Measurements indicate that typical values for these parameters are 16.0 db and 33 degrees.**

Worst case circuit margins using a gain of 11.5 db show that a margin of at least -0.8 db*** is attainable on the EASEP to Earth link. Thus, if the 27 degree beamwidth

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*Per telephone conversation with Dr. F. Wainio of Bendix Corporation, March 6, 1969.

**EASEP Familiarization Manual, Bendix Corporation, dated February 15, 1969.

***Corresponds to a data rate of 10,600 bits per second and 85' ground antenna.

(specification value) is assumed, a worst case circuit
margin of about 0 db is obtained when the 13 degree typical
peak pointing error occurs. If the 33 degree beamwidth
(measured value) is assumed, a worst case circuit margin
greater than 0 db is obtained, even when the peak pointing
error is as large as 15 degrees.

From the above discussion, one can conclude that
loss of communications on the EASEP to Earth link should
not occur for any significant percentage of time.

K. H. Schmid

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